4

4. Summary of Project Changes

4 Summary of Project Changes

4.1 Introduction

A number of project aspects have been improved or optimised since the submission of the Draft Environmental Impact Statement (EIS) and are summarised below (**Supplementary EIS Section 4.2**). These have been updated on the basis of improved or additional information, further assessment work and input from project stakeholders provided through the consultation process. A number of improvements and refinements have also been made to the assessment models. These are described below in **Supplementary EIS Section 4.3**.

Further information on the proposed project changes is provided in **Supplementary EIS Section 6 – Simplified Project Description**. **Supplementary EIS Section 5 – Potential Environmental Impact of Project Changes** provides updated impact assessment information as a result of these proposed project changes.

Minor operational changes approved through the Mining Management Plan (MMP) process are not described as they are outside the scope of the EIS (**Draft EIS Section 1.4 – EIS Scope and Approach**). Where relevant, they have been incorporated into the modelling and assessments presented in **Supplementary EIS Section 5 – Potential Environmental Impact of Project Changes** and **Supplementary EIS Section 6 – Simplified Project Description**.

4.2 Project Changes

The proposed project changes are summarised below and are grouped by project domain (refer to **Draft EIS Figure 3-1** for domain definitions). **Supplementary EIS Table 4-1** below provides further information, a comparison with what was proposed in the Draft EIS and the reasons for the changes. The table also provides a cross reference to the relevant Supplementary EIS section or appendix that addresses the potential environmental impacts of the proposed change.

In summary, the project changes that have been made since the submission of the Draft EIS include:

Open cut domain:

- Incorporation of greater clarity on the adaptive management process and how it applies to the final void closure decision making process.

North Overburden Emplacement Facility (NOEF) domain:

- Substitution of the proposed compacted clay layer (CCL) within the NOEF cover system with a geosynthetic liner GSL, in order to provide improved performance and reduced long-term risks.
- Optimisation of the NOEF cover system above the GSL to reflect revised cover system construction and performance requirements.
- Optimisation of the NOEF low permeability foundation thickness from 500 mm to 250 mm based on improved cover system performance achieved by the GSL, increased density and reduced permeability of the CCL due to loading by the NOEF above, reduce risks of instability near the toe due to high pore pressures, and the lack of sensitivity of NOEF long-term performance to this parameter.

- Adjustment of the upper NOEF batter slope from a 1V:2.5H slope to a shallower 1V:3H slope, in order to provide better environmental performance and enable easier construction and maintenance.
- Minor modification of stockpile/borrow locations and associated road network to the north of the NOEF including a small civil fleet infrastructure area.
- Minor modification to the NOEF south eastern stage outer extent to facilitate water management system infrastructure.
- A change to the MRM4 cultural heritage site relocation. The relocated MRM4 cultural heritage site will be placed within the boundary of the MRM3 cultural heritage site, instead of the previously proposed location at the base of Barramundi Dreaming.
- An administrative change to remove the East Perimeter Runoff Dam (EPROD) from the project that is the subject of the EIS.

Tailings Storage Facility (TSF) domain:

- Removal of the TSF East Quarry from the proposal.
- An administrative change to incorporate the combined use of TSF Cells 1 and 2 for life of mine (LOM) tailings storage in the project that is the subject of the EIS.

Table 4-1 Project Changes since Draft EIS

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
Open Cut				
Final void closure sequence	The flow through mine pit lake as a secondary path was the preferred closure alternative for the open cut. This involved a three staged closure sequence which would require the Mine Levee Wall to be breached at the upstream and downstream ends. The McArthur River diversion channel would remain as the primary flow path with only intermittent high flows through the mine pit lake. After the tailings relocation is completed in 2047 the water from the McArthur River would be harvested during high flow periods and discharged into the open cut final void. The mine pit lake would initially remain isolated while the lake hydrodynamics and the water quality are being monitored against predictions. Once the water in the mine pit lake demonstrated acceptable quality levels and the models provided a confident representation of observed conditions, a section of the downstream levee would be removed to allow for water exchange between the mine pit lake and the McArthur River during periods of high flow. The mine pit lake and McArthur River would then be monitored for a further period to assess mine pit lake performance against predictions and established criteria. Finally, a section of the upstream mine levee wall would be removed to allow a second high water flow inlet and hence establishment of a flowthrough system in periods of high flow in the McArthur River. Refer to **Draft EIS Section 3.4.6.2.1.1** and **Draft EIS Section5.5.2.2.2.3**	The final void closure sequence will remain the same as was presented in the Draft EIS however, following review of stakeholder comments and further technical assessment work, the mine pit lake may remain as a 'backflow' system rather than being progressed to a 'flow through' system. Additional limnological and mine pit lake modelling assessments (**Supplementary EIS Section 4.3**) have determined that both the 'backflow' and the 'flow through' mine pit lake scenarios are both effective low-risk closure proposals for the final void. Both of these proposals are preferable over the 'Isolated void' scenario. However, the isolated void stage remains necessary in the establishment of the final mine pit lake and remains a viable fall-back position (with additional management measures) should monitoring indicate that either of the 'backflow' or 'flow-through' mine pit lake scenario is not achieving required performance criteria as per modelling. The Adaptive Management Framework (**Supplementary EIS Appendix R – Adaptive Management Report**) formalises the decision making process that would be adopted to determine the timing, staging and sequencing of final void closure, mine pit lake development and establishment of connection with the McArthur River. This identifies key stakeholders, information requirements, decision making processes and feedback loops for the management of the final void closure. This facilitates regulatory approval of each closure stage on the basis of decision making criteria and assessment outcomes. It also facilitates reverting to a previous stage if the mine pit lake is under-performing. Further discussion of the final void closure sequence is provided in **Supplementary EIS Appendix D – Pit Lake Closure with Strategic Riverine Connectivity**.	Stakeholder comments received following review of the Draft EIS. Further modelling has identified that both 'backflow' and the 'flow-through' mine pit lake scenarios are effective low risk closure proposals for the final void. The Adaptive Management process provides a logical decision making process for the transition from an isolated mine pit lake, to a backflow mine pit lake and on to the proposed long term flowthrough mine pit lake. It also facilitates the collection of data, further stakeholder and regulatory consultation and additional assessment in the interim period. It is therefore appropriate at this stage to maintain flexibility in relation to the final void closure scenario. Both are effective closure options.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix R – Adaptive Management Framework** **Appendix L – Updated Mine Pit Lake Modelling Report** **Appendix M – Updated Mine Pit Lake Modelling Report** **Appendix O – Revised Limnology Study** **Appendix D – Pit Lake Closure with Strategic Riverine Connectivity.**

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
NOEF				
NOEF cover system – barrier layer material	The NOEF cover system barrier layer material was previously proposed to comprise a CCL. This layer would be 0.5 m thick and would function as a barrier layer to resist water infiltration and limit oxygen entry into the NOEF. Refer to **Draft EIS Section 3.4.4.3.1**	Following further work including improved modelling and the resolution of some engineering uncertainties, McArthur River Mining proposes to use a GSL as the barrier layer in the cover system of the NOEF instead of the previously proposed CCL (**Supplementary EIS Appendix H – Geosynthetic Liner Design Details**). The CCL cover system remains a viable cover system solution with a matching monitoring and maintenance program and is still proposed to be implemented in other MRM areas (e.g. West Overburden Emplacement Facility).	The use of a GSL in the cover system of the NOEF was identified as a potential solution in the Draft EIS. A CCL was however selected for a number of reasons. Following stakeholder feedback and further technical evaluation, McArthur River Mining has decided to adopt world best practice with the incorporation of a GSL.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix G – GSL Cover Design Report** **Appendix H – Geosynthetic Liner Design Details** **Appendix K – Revised NOEF Unsaturated Flow Modelling (TOUGH 2) Report** **Appendix L – Revised Groundwater Modelling Report** **Appendix N – Updated Water Balance and Waterways Modelling Report**

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
NOEF cover system – upper cover system components	The Draft EIS previously proposed the following layers above the CCL on the NOEF plateau: • 0.1 m topsoil; • 1.5 m growth media (alluvium); and • 0.5 m drainage layer. The Draft EIS previously proposed the following layers above the CCL on the NOEF batters: • 0.1 m topsoil; • 2.0 m growth media (Breccia); and • 0.5 m drainage layer. Refer to **Draft EIS Section 3.4.4.3.3** and **Draft EIS Figure 3-47**	Due to the proposed utilisation of a GSL as the cover system barrier layer, the upper cover system configuration has been modified to optimise performance. The following layers are now proposed above the GSL on the NOEF plateau: • 0.1 m topsoil; • 0.6-0.9 m growth media (alluvium); • 0.2-0.5 m drainage layer (breccia); and • 0.2-0.3 m GSL overliner (alluvium) This will achieve a total thickness above the barrier layer of at least 1.5 m. The following layers are now proposed above the GSL on the NOEF batters: • 0.1 m topsoil; • 1.1-1.4 m growth media and drainage layer (breccia); and • 0.2-0.3 m GSL overliner (alluvium or screened breccia). This will achieve a total thickness above the barrier layer of at least 1.5 m. Both plateau and batter cover systems include a 0.2 m layer of Heavy Media Reject or fine-grained alluvial material below the GSL as a bedding layer.	The previously proposed CCL barrier layer required the moisture levels within the clay to remain above 85% saturation to maintain the required performance as a barrier to water and oxygen. This would be achieved by appropriate materials selection and thickness of the layers above the CCL. The adoption of a GSL barrier layer within the cover system, replacing the CCL, means that the CCL no longer requires protection from drying and desiccation. Therefore the overlying growth media layer has been reduced to a thickness tailored for erosion protection; cover drainage and sustaining the target vegetation cover.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix G – GSL Cover Design Report**

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
NOEF low permeability foundation	The Draft EIS previously proposed a low permeability foundation of 500 mm thickness across future NOEF foundation areas. Refer to **Draft EIS Section 3.4.4.3.3.1**	Due to the proposed utilisation of a GSL in the cover system, the minimum thickness of the low permeability foundation is proposed to be reduced to 250 mm.	The GSL barrier layer provides very effective infiltration 'source control' meaning that seepage is significantly reduced and therefore there is a reduced requirement for the basal CCL to be utilised as a 'pathway control'. Modelling shows that a low permeability foundation is effective during the construction phase, but relatively unimportant in determining the fate of infiltration once the cover system has been established. Staged rehab of the dump means that the construction phase is relatively limited in duration for the new NOEF stages where foundation works will be completed.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix K – Revised NOEF Unsaturated Flow Modelling (TOUGH 2) Report** **Appendix L – Revised Groundwater Modelling Report**
NOEF upper slope angle	The NOEF has been designed with a maximum height of 140 metres (m). To limit erosion and better mimic natural landforms, the geometry of the NOEF batters will be trilinear concave as follows: lower-slope section: 0-55 m elevation; batter angle 1V:4:5H; mid-slope section: 55-100 m elevation; batter angle 1V:3.5H; and upper-slope section: 100-140 m elevation; batter angle 1V:2.5H Refer to **Draft EIS Section 3.4.4.3.3**	The NOEF will maintain a maximum height of 140 m, however a minor change to the upper slope of the trilinear concave design is proposed. The batter angle has been reduced to 1V:3H from 1V:2.5H. Overburden material placement is not affected by this change. The plateau footprint would change slightly, by approximately 8 hectares.	Whilst the test work, modelling and analysis confirm that the 1V:2.5H slope would be stable, McArthur River Mining proposes to reduce the slope to 1V:3H as part of its commitment to greater environmental performance.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix E – Updated Geotechnical Report**
NOEF stockpile/borrow footprints and locations	A number of stockpile and borrow pit locations were proposed to the north of the NOEF. Refer to: • **Draft EIS Figure 3-18;** • **Draft EIS Figure 3-19;** • **Draft EIS Figure 3-20;** • **Draft EIS Figure 3-21;** • **Draft EIS Figure 3-22;** • **Draft EIS Figure 3-23;** • **Draft EIS Figure 3-24;** • **Draft EIS Figure 3-25;** and • **Draft EIS Figure 3-26.**	The footprints and locations of the stockpiles and borrow pits and associated road alignment have been modified slightly. A small civil infrastructure area has also been incorporated to provide facilities in close proximity to the working area north of the NOEF. Refer to **Figure 6-3** in **Supplementary EIS Section 6 – Simplified Project Description**.	The footprints have been modified based on more detailed design work and to allow for a greater buffer around the MRM3 cultural heritage site. The small civil infrastructure area provides facilities in close proximity to the working area.	**Section 5 – Potential Environmental Impact of Project Changes**

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
NOEF south eastern boundary	The NOEF footprint was presented in the Draft EIS. Refer to: • **Draft EIS Figure 3-18;** • **Draft EIS Figure 3-19;** • **Draft EIS Figure 3-20;** • **Draft EIS Figure 3-21;** • **Draft EIS Figure 3-22;** • **Draft EIS Figure 3-23;** • **Draft EIS Figure 3-24;** • **Draft EIS Figure 3-25;** and • **Draft EIS Figure 3-26.**	The boundary of the NOEF southeastern corner has been realigned towards the west by approximately 50 m. Refer to **Figure 6-3** in **Supplementary EIS Section 6 – Simplified Project Description.**	The boundary has been realigned to provide additional space for toe drains and outlet collection pits (part of the water management infrastructure) whilst maintaining a standoff from cultural boundaries.	**Section 5 – Potential Environmental Impact of Project Changes**
Receiving location of the removed MRM4 artefact site.	McArthur River Mining agreed with Gurdanji custodians that in order to preserve the MRM4 cultural heritage, it would be relocated to a position east of the current location, at the base of Barramundi Dreaming. This location was selected by the Gurdanji custodians. Refer to **Draft EIS Section 12.6.2.3.2**	Through discussions with the Aboriginal Areas Protection Authority and the Heritage Branch, and with the agreement of the Custodians, the MRM4 cultural heritage site is now proposed to be moved to the MRM3 cultural heritage site, to the north of the NOEF.	Following further consultation, the MRM3 cultural heritage site was determined to be a more appropriate location and avoids interference with the Barramundi Dreaming sacred site.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix Q – Stakeholder Consultation Report**
Administrative change to remove EPROD from EIS project definition	The Draft EIS identified that EPROD was to be assessed as part of the project EIS. This was proposed because construction wasn't expected to be required until 2019, so progressing this through the EIS process was appropriate. Refer to **Draft EIS Table 3-6.**	With the large wet season of 2016/17 and high water inventories on site, construction is required to be brought forward into the dry season of 2018. As there is no definitive end date to the EIS process, there is a risk that approval to construct EPROD may be delayed as part of the EIS process. Such a delay would place capacity within the water management system under increased strain. Excessive rain in the 2017-18 wet season could result in increased strain on the water management system, increasing risk of open cut inundation due to excess water storage requirements. This would impede mining and processing operations. Approval for EPROD would be sought through MMP amendment in early 2018 under the Mining Management Act.	EPROD is proposed to be removed from the EIS project definition to facilitate earlier approval through an MMP and construction prior to the 2017-18 wet season. This is to provide greater environmental and operational protection.	**Section 5 – Potential Environmental Impact of Project Changes**
TSF				
Removal of the TSF East Quarry	The Draft EIS proposed the TSF East Quarry to be located between the accommodation camp and the TSF. Refer to **Draft EIS Figure 3-14.**	The TSF East Quarry is no longer proposed. Sufficient material is located within the Woyzbun Quarry, however material may be sourced from other borrow locations within the mineral leases, in accordance with MRM borrow pit guidelines. Borrow locations will be confirmed in the relevant Mining Management Plan.	Further test work has determined that the TSF East Quarry material is not suitable for its intended use.	**Section 5 – Potential Environmental Impact of Project Changes**

Project Aspect	Draft EIS Project Description and Section References	Supplementary EIS Description of Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
Administrative change to incorporate TSF LOM Plan into the EIS project definition	Alternative LOM tailings management options were evaluated in 2015, considering technical factors, safety, potential environmental impacts, closure, and costs. The preferred option was to use Cells 1 and 2 in a combined larger single cell for the LOM, to a higher elevation, with a seepage interception trench to the north of Cell 1. The revised LOM plan was included in **Draft EIS Appendix R – TSF – Life of Mine Plan**. The life of mine plan describes how the larger active cell will improve water management and reduce embankment failure risks, and the smaller disturbed footprint will reduce in lower seepage during operations and closure. The seepage interception trench (which would be required for any cell combination) would further reduce potential impacts to receiving environment. The expert Independent Tailings Review Board, installed by the Department of Primary Industry and Resources (DPIR) to advise McArthur River Mining and review the TSF plans and works for the DPIR, endorsed this plan. The Draft EIS proposed that the combining of TSF Cells 1 and 2 for LOM tailings storage was excluded from the EIS project definition and would be approved through a MMP amendment in 2017 under the Mining Management Act. Refer to **Draft EIS Section 3.2.2.7.**	While the DPIR agreed in 2017 to assess the change, DPIR were uncertain as to whether the change in plan for Cell 1 (from being decommissioned and rehabilitated early to being used for the LOM) could be assessed through the MMP process. As such, this change has been included in the Supplementary EIS. **Supplementary EIS Appendix I – Updated Tailings Storage Facility Life of Mine Plan** contains the latest TSF LOM plans. All of the impact assessments completed in both the Draft EIS and Supplementary EIS have been based on the revised TSF LOM plan with a combined Cell 1 and 2. Hence there is no requirement for assessment changes or updates.	The TSF LOM Plan has been incorporated into the EIS process due to uncertainty associated with DPIR's ability to approve the proposed use of the TSF Cell 1 footprint through MMP amendment under the Mining Management Act.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix I – Updated Tailings Storage Facility Life of Mine Plan** **Appendix L – Revised Groundwater Modelling Report** **Appendix N – Updated Water Balance and Waterways Modelling Report**

4.3 Assessment Changes

As discussed above, a number of improvements and refinements have been made to the assessment models utilised in the Draft EIS. The results of these are presented in this Supplementary EIS and a validation of and update to the modelling work completed in the Draft EIS. The modelling assessment changes include:

- Validation and substitution of the DUMPSIM NOEF unsaturated flow modelling with TOUGH2/GOLDSIM NOEF unsaturated flow modelling.
- Updates of the hydrodynamic modelling of the mine pit lake limnology, including assessment of the various McArthur River connectivity scenarios and 'extreme event' conditions.
- Updates of the mine pit lake, groundwater and waterways models to account for the updated outputs from the above models, which also incorporate relevant performance updates from the project changes identified in **Supplementary EIS Table 4-1**. These models were also updated with additional data and information gathered since the Draft EIS was submitted. Further information on the additional data incorporated is provided in the respective technical assessment appendices. These are identified in **Supplementary EIS Table 4-2** below.

Additional sensitivities have also been assessed in a number of the modelling sequences. Further information is provided in:

- **Supplementary EIS Section 5 – Potential Impacts of Project Changes;**
- **Supplementary EIS Appendix K – Revised NOEF Unsaturated Flow Modelling (TOUGH2) Report;**
- **Supplementary EIS Appendix L – Revised Groundwater Modelling Report;**
- **Supplementary EIS Appendix M – Updated Mine Pit Lake Modelling Report;**
- **Supplementary EIS Appendix N – Updated Water Balance and Waterways Modelling Report; and**
- **Supplementary EIS Appendix O – Revised Limnology Study.**

Table 4-2 Assessment Changes since Draft EIS

Assessment Aspect	Draft EIS Assessment Approach and Section References	Supplementary EIS Description of Assessment Change	Reason for Change	Assessment of Change Cross Reference (Supplementary EIS)
NOEF unsaturated flow modelling	The unsaturated flow modelling in the Draft EIS utilised the DUMPSIM modelling package to determine the volume and quality of NOEF seepage reporting as toe and basal seepage. Refer to **Draft EIS Appendix P – NOEF Mine Drainage Report**.	The TOUGH2/GOLDSIM modelling software was utilised in the Supplementary EIS assessments to determine NOEF seepage characteristics. This also incorporated relevant project changes described in **Supplementary EIS Table 5-1**.	The modelling software was substituted primarily as a validation of the DUMPSIM modelling. This was commenced prior to the public consultation period. Utilisation of the TOUGH software was subsequently requested in a number of Draft EIS submission comments.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix K – Revised NOEF Unsaturated Flow Modelling (TOUGH 2) Report**
Mine Pit Lake Limnology Modelling	The Draft EIS presented hydrodynamic modelling of the mine pit lake limnology to determine the effects of stratification in the flow through scenario. To be very conservative, the effects of stratification were not applied to the final void model and therefore the waterways model, which assumed a fully mixed mine pit lake water quality. The assessment of downstream impacts was therefore very conservative. Refer to **Draft EIS Appendix V – Final Void Limnology Assessment Report**.	The hydrodynamic modelling has been updated with the results from the updated unsataured flow, groundwater and surface water modelling. The effects of the stratification have now been incorporated into the mine pit lake water quality modelling. Assessment of the 'backflow' mine pit lake was also completed along with a 'worst case' scenario that assessed the cumulative effects of cyclonic winds, flooding and mine pit lake inlet failure.	The hydrodynamic modelling has been updated to incorporate new input data from other revised models, refine a number of modelling parameters and attributes and to address comments provided during the public consultation period. Stratification has been included in the updated modelling to present an assessment more reflective of likely mine pit lake conditions.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix O – Revised Limnology Study**
Final void, groundwater and waterways models	The Draft EIS presented final void water quality, groundwater and surface water site wide models to assess the long term impact of the project on the water environment. Refer to **Draft EIS Chapter 8 – Water Resources, Draft EIS Appendix T – Groundwater Impact Assessment Report** and **Draft EIS Appendix U – Surface Water Impact Assessment Report**.	The mine pit lake water quality, groundwater and surface water site wide models have been updated to incorporate both the revised assessment outputs determined from the model updates presented above and the relevant project changes described in **Supplementary EIS Table 5-1**. These models were also updated with additional data and information gathered since the Draft EIS was submitted. Further information on the additional data incorporated is provided in the respective technical assessment appendices.	This was completed to provide a revised, up-to-date assessment of the proposed project and to demonstrate the effectiveness of the relevant project improvements proposed in **Supplementary EIS Table 5-1**.	**Section 5 – Potential Environmental Impact of Project Changes** **Appendix L – Revised Groundwater Modelling Report** **Appendix M – Updated Mine Pit Lake Modelling Report** **Appendix N – Updated Water Balance and Waterways Modelling Report**